

NASA TECH BRIEF



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Method of Improving Contact Bonds in Silicon Integrated Circuits

The problem:

Producing stable and reliable metallic systems for interconnections, contact pads, and bonded leads in silicon planar integrated circuits. In a conventional fabrication, employing interconnection metal of vapor-deposited aluminum, contact pads of vapor-deposited gold on chromium, and bonded lead wires of gold, metal-to-metal contact bonds are formed. The intermetallic compounds present in the interfaces result in a degradation of bond strength, an increase in ohmic contact resistance, and eventually in open circuits caused by voids which arise from volumetric phase mismatch.

The solution:

A method of fabrication based on substrate isolation of the interconnection metal from the contact pad and bonded wire.

How it's done:

The interconnections are separated from the contact pads by a barrier domain of bulk silicon substrate material which has been degenerately doped. The entire region, which is comprised of the interconnection metal (vapor-deposited aluminum), the degenerate substrate section, and the contact pad (vapor-deposited gold on chromium), is bounded by a diffused isolation ring. Degradation is avoided as the metal compatibility need only be between the respec-

tive land metals and the substrate material, and not between all the metals collectively. The relatively thick substrate barrier prevents any phase reactions between the interconnection and pad-wire components of the metal assemblage. The preparation of this specific interconnection-contact-bonding aggregation involves techniques that are essentially standard to integrated circuit processing: planar diffusion, vapor deposition, and photoengraving.

Notes:

1. This approach may be applied not only to silicon integrated circuits but also to circuits fabricated from the more exotic semiconductor materials and to hybrid and thin-film circuits.
2. Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
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Patent status:

No patent action is contemplated by NASA.

Source: M. A. Schuster and W. J. Lytle
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